

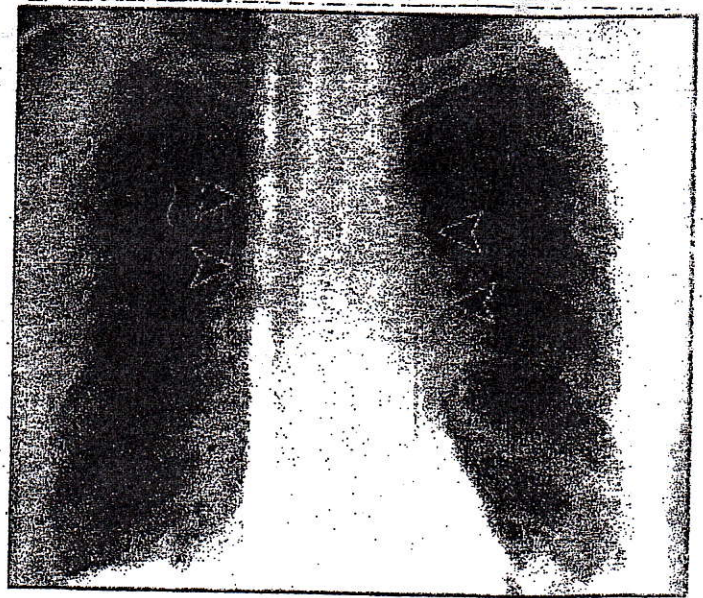
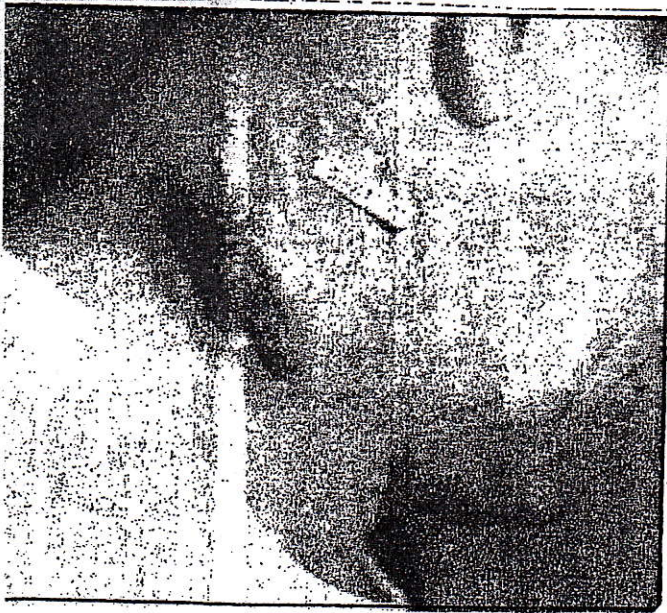


# GRAM – POSITIVE RODS

SPORE – FORMING GRAM-  
POSITIVE RODS .

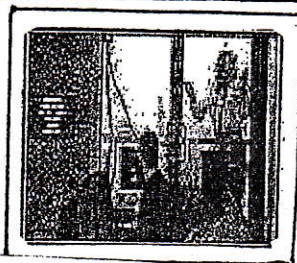
2) AEROBIC RODS :

GENUS: BACILLUS.



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16.3.14.



مركز الشامل للخدمات الطلابية



## GRAM - POSITIVE RODS

There are four medically important genera of gram - positive rods : *Bacillus*, *Clostridium*, *Corynebacterium*, and *Listeria*. *Bacillus* and *Clostridium* form spores, whereas *Corynebacterium* and *Listeria* do not. Members of the genus *Bacillus* are aerobic, whereas those of the genus *Clostridium* are anaerobic (table 17-1).

### SPORE - FORMING GRAM - POSITIVE RODS .

#### GENUS: BACILLUS .

There are two medically important *Bacillus* species : *Bacillus anthracis* and *Bacillus cereus* .

##### 1. *Bacillus Anthracis* →

Disease B anthracis causes anthrax, which is common in animals but rare in humans.

IS ONE OF THE LARGEST BACTERIA. = *Bacillus anthracis*.  
ACCORDINGLY ANTHRAX IS A ZOONOTIC DISEASE.

**Important Properties** *B anthracis* is a large gram - positive rod with square ends, frequently found in chains (  $4-8 \mu\text{m} \times 1-1.5 \mu\text{m}$  ) . Its antiphagocytic capsule is composed of D- glutamate. ( this is unique - capsules of other bacteria are polysaccharides ). It is nonmotile, whereas other members of the genus are motile. Spores are highly resistant to heat, chemicals, and disinfectants, AND DRYING . IT IS DESTROYED BY AUTOCLAVING .

FROM OLD CULTURES

STREPTOBACILLI  
SPORES ARE  
OVAL AND  
CENTRAL

FROM YOUNG - CULTURES,  
Spores are not formed.

④ D-glutamate Capsule:

1. Have high-molecular-weight.
2. Is a polypeptide.
3. IT IS A haptan.
4. D-form-glutamic-Acid.
5. ALSO CALLED Aggressin, which stops phagocytosis.
6. NON-TOXIC.
7. Starts the disease.

7. The capsule may surround the entire chain of bacilli.



**Transmission** Spore of the organism persist in soil for years and decades. Humans are infected by spores or animal products such as hides, bristles, and wool or by contact with sick animals. The portals of entry are the skin, mucous membranes, and respiratory tract.

**Pathogenesis** B anthracis invades the host and produces **anthrax toxin**, which has three components : protective antigen (PA), lethal factor (LF) , and edema factor (EF). Edema factor, an exotoxin, is an **adenylate cyclase** dependent on protective antigen for its binding and entry into the cell. Lethal factor in the presence of protective antigen is rapidly fatal for mice. Lethal factor is a protease that cleaves the phosphokinase that activates the mitogen- activated protein kinase ( MAPK) signal transduction pathway. This pathway controls the growth of human cells, and cleavage of the phosphokinase inhibits cell growth.

**TABLE 17-1 GRAM – POSITIVE RODS OF MEDICAL IMPORTANCE.**

Genus	Anaerobic Growth	Spore Formation	Exotoxins Important In Pathogenesis
Bacillus	-	+	+
Clostridium	+	+	+
Corynebacterium	-	-	+
Listeria	-	-	-

**Clinical Findings** The typical lesion is a painless ulcer with a black eschar ( crust, scab). Local edema is striking. The lesion is called a "**malignant pustule**" Untreated cases progress to bacteraemia

④: Also called **Holotoxin**. An **Exotoxin**. Complete-toxin, plays the major-role of the disease, but not the capsule.



in A Safety-Cabinet

+ wearing protective clothing

Life-saving.

seen in smears of exudes. Colonies  
- WITH MEDUSA-head - colonies.  
No serologic tests are useful except

[illegible]

(Disintegrated - capsules)

dead-animals are buried in deep pits to prevent

Protective clothing should be worn by persons at risk of exposure.

containing purified protective antigen as immunogen, without dead-bacteria, no living bacteria. only Aluminum-hydroxide (Adjuvant) is added to enhance the immunogenicity of

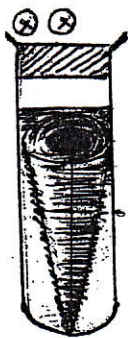
القائمه السبع

rapid frying. The spores germinate when rice is kept warm for many

Ascoli

3

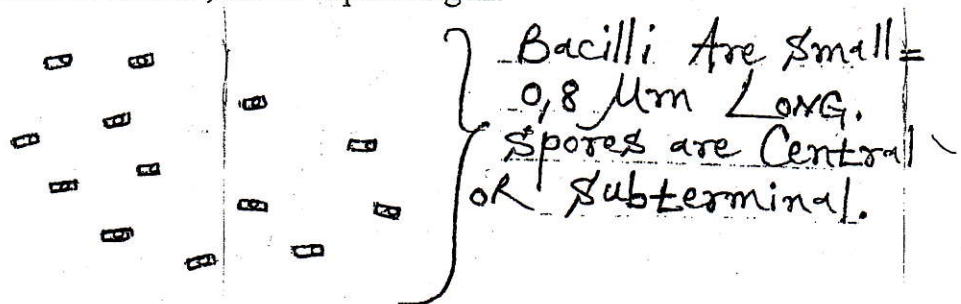
2-9m of





hours ( eg, reheated fried rice). The portal or entry is the gastrointestinal tract. Rice must be stored below +5°C or above +60°C where vegetative - forms will not be formed, and the toxin will not be produced.

**Pathogenesis** *B cereus* produces two enterotoxins. The mode of action of one of the enterotoxins is the same as that of cholera toxin; ie it ADP - ribosylates a G protein, which stimulates adenylate cyclase and leads to an increased concentration of cyclic AMP within the enterocyte. The mode of action of the other enterotoxin resembles that of staphylococcal enterotoxin: ie , it is a superantigen.



**Clinical Findings** There are two syndromes : (1) one has a short incubation period (4 hours) and consists primarily of nausea and vomiting , similar to staphylococcal food poisoning ; (2) the other has a long incubation period (18hours ) and features of watery , nonbloody diarrhea, resembling clostridial gastroenteritis.

**Laboratory Diagnosis** This is not usually done.

**Treatment** Only symptomatic treatment is given.

**Prevention** No specific means of prevention. Rice should not be kept warm for long periods, i.e for 6-12 hours at  $+22^{\circ}\text{C} \rightarrow +37^{\circ}\text{C}$ .

NOTE: *Staph. aureus* enter food via food-handlers ; Whereas other bacteria causing food-poisoning enter food via soil, sewage, feces and water  $\rightarrow$  Saprophytes in soil.



# THE MODES OF ACTIONS OF EXOTOXINS :-

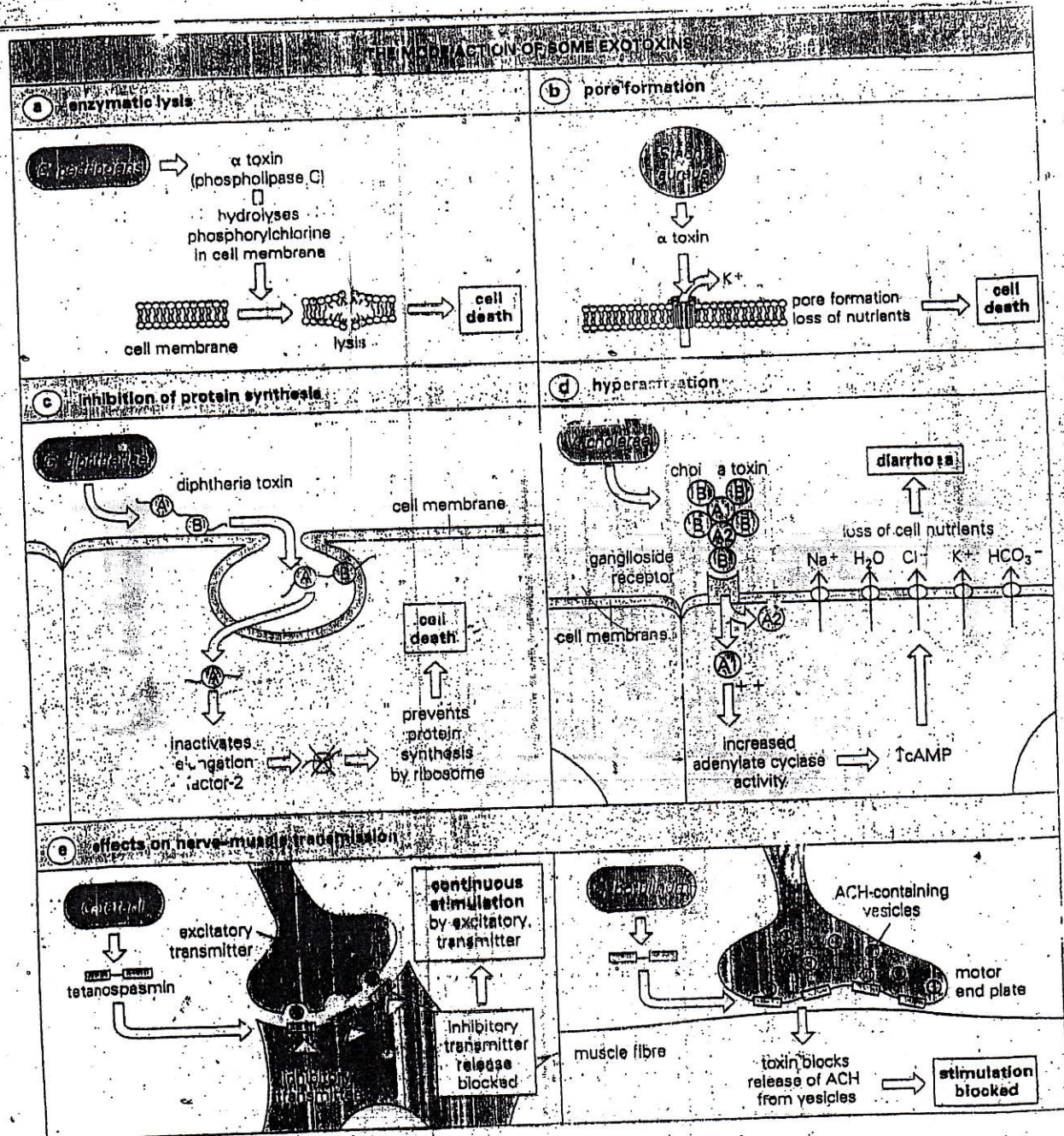


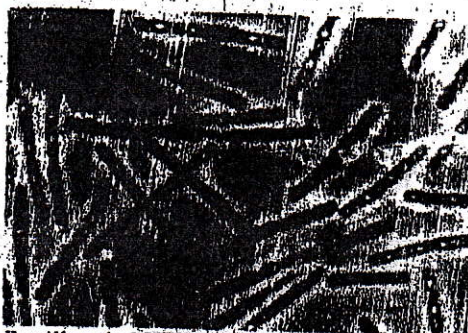
Fig. 16.4 The mode of action of some exotoxins. Bacterial toxins act in a variety of ways. Often the toxin is a two-chain molecule, one chain being concerned with entry into cells while the other has inhibitory activity against some vital function.





*Bacillus anthracis*. Gram stain. The cells have characteristic squared ends. The endospores are ellipsoidal shaped and located centrally in the sporangium. The spores are highly refractile to light and resistant to staining.

*Bacillus thuringiensis* is distinguished from *B. cereus* or *B. anthracis* by its pathogenicity for Lepidopteran insects (moths and caterpillars) and by production of an intracellular **parasporal crystal** in association with spore formation. The bacteria and protein crystals are sold as "Bt" insecticide, which is used for the biological control of certain garden and crop pests.



*Bacillus thuringiensis*. Phase Photomicrograph of vegetative cells, intracellular spores (light) and parasporal crystals (dark).

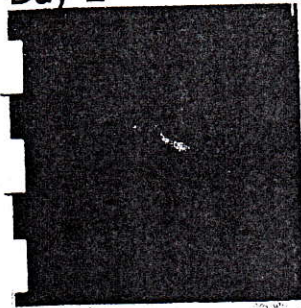
*Bacillus cereus* is a normal inhabitant of the soil, but it can be regularly isolated from foods such as grains and spices. *B. cereus* causes two types of food-borne intoxications (as opposed to infections). One type is characterized by nausea and vomiting and abdominal cramps and has an incubation period of 1 to 6 hours. It resembles *Staphylococcus aureus* food poisoning in its symptoms and incubation period. This is the "short-incubation" or emetic form of the disease. The second type is manifested primarily by abdominal cramps and diarrhea with an incubation period of 6 to 24 hours. Diarrhea may be a small volume or profuse and watery. This type is referred to as the "long incubation" or diarrheal form of the



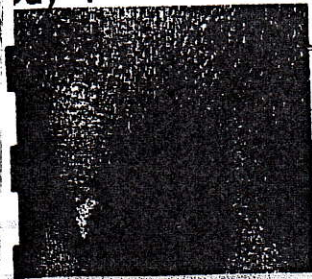
## **Anthrax: Images: Cutaneous Anthrax**

### **Cutaneous Anthrax—Vesicle Development**

Day 2



Day 4

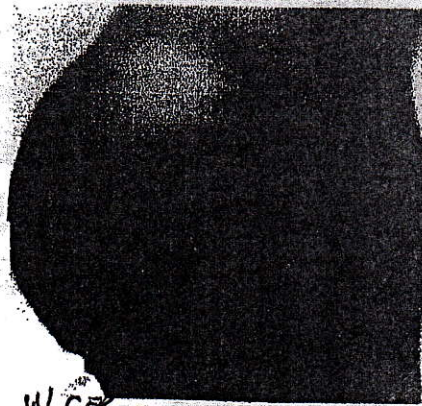


Notice the edema and typical lesions

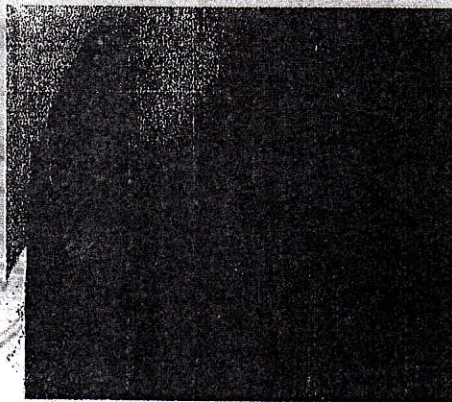
Eschar formation





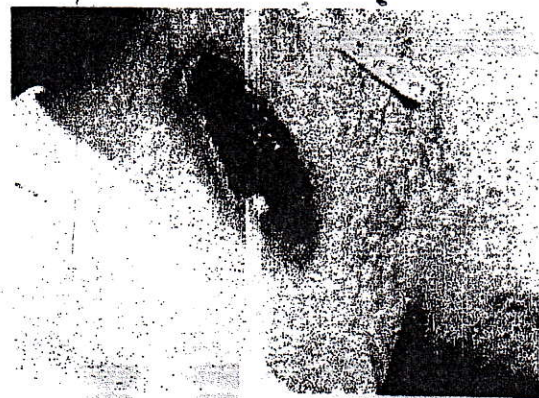
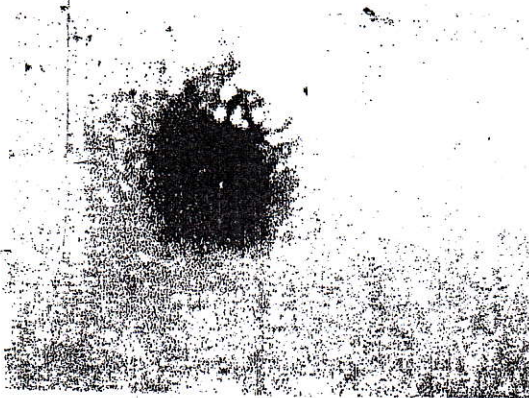


~~ULCER~~  
Ulcer and vesicle ring



Black eschar, redness remains

Day 6 : -



Left image: forearm lesion on Day 7—vesiculation and ulceration of initial macular or papular anthrax skin lesion.

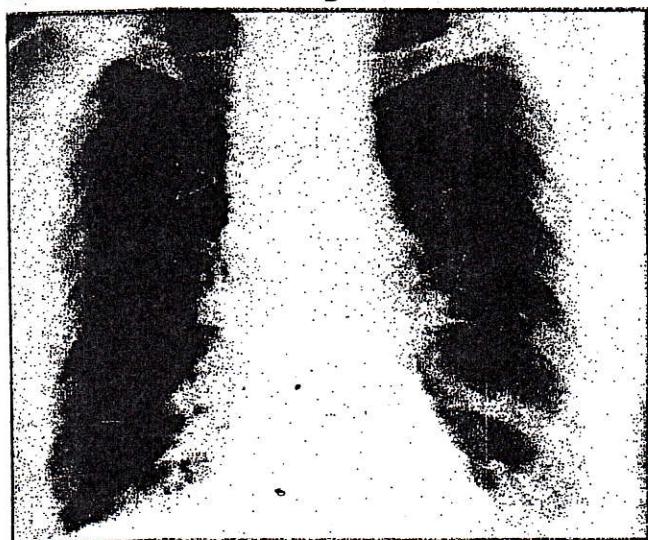
Right image: eschar of the neck on Day 15, typical of the last day of lesion.  
From Binford CH, Connor DH, eds. pathology of tropical and extraordinary—  
Diseases. Vol 1. Washington DC: AFIP:1976:119. AFIP negative 71-1290-2 .



## **Anthrax: Images: Inhalational Anthrax**

### **Inhalational Anthrax**

Mediastinal widening with inhalational anthrax (JAMA 1999;281:1735-1745)



Mediastinal widening and pleural effusion on Chest X-Ray in inhalational anthrax

